once and then key in a short CQ or your call. Remember that data is not written to the memory until the first paddle closure. Do not leave too much space between words; the memory will interpret this as the end of the message. If you make a mistake, simply press WRITE again and start over. It is not necessary to press a mouse pushbutton again unless you intend to write to a different memory. Once you have completed the message to be stored, wait the equivalent of five dashes or more and press ABORT.

To play back the stored message, simply press the mouse pushbutton that corresponds to the memory you just programmed, and the message should be played back exactly as sent. If the mouse is not connected, you can play back the memory by pressing READ. If your message stops in the middle, chances are that the keyer interpreted a long space as the end of the message; this is how it achieves variable message length.

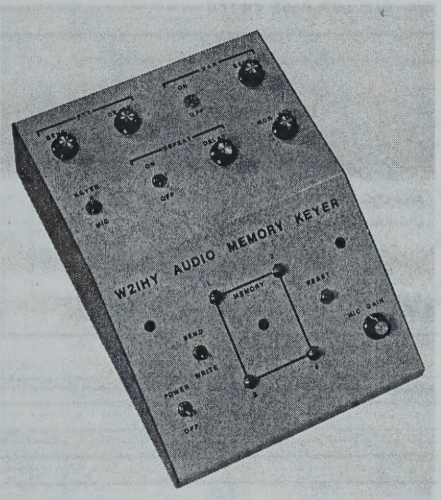
To use the auto-repeat feature, rotate the DELAY pot counter clockwise and press AUTO. The message currently selected by the mouse will be played, then there will be a pause (set by the DELAY pot), and the message will be played again. This will continue until ABORT is pressed or one of the paddles is closed.

Next, test the keying outputs by connecting the appropriate output to a radio. Be sure to check your owner's manual for the specification of the voltage and current present on the key terminals, as the maximum drain-to-source rating of the keying MOSFETs (Q3 and Q5) is 60 V at 400 mA. If you are not sure which type of keying output is required, again check the owner's manual. This completes the testing. CQ DX CQ DX CQ DX DE...

If you have used the unit for a few QSOs and feel that the paddles just don't feel quite right in either iambic or non-iambic modes, a slight capacitor value change might be in order. There are two one-shots on the 8044 (one for the dot, one for the dash) that are used to briefly inhibit their respective paddles. This feature, sometimes called "anti echo," prevents insertion of extra dots or dashes. To adjust the feel, alter the value of C5 (for the dash paddle) or C6 (for the dot paddle) by an order of magnitude. This is strictly trial and error, and be sure to take your time if you decide to try this.

The W2IHY Audio Memory Keyer

A digital voice recorder (called a DVR, or audio keyer) is the audio equivalent of a CW memory keyer. A CW memory keyer stores Morse code messages for retransmitting. A DVR stores digitized audio messages for retransmission. Digital voice recorders are gaining popularity with SSB/FM contesters. With a DVR, memory segments can be loaded with short, frequently used messages (such as CQs and contest exchanges). These messages can then be easily retransmitted. Other uses for the audio keyer include record and playback of received audio during a QSO and voice identification for a repeater. In a few years audio keyers will be as common a station accessory as CW memory keyers are today.



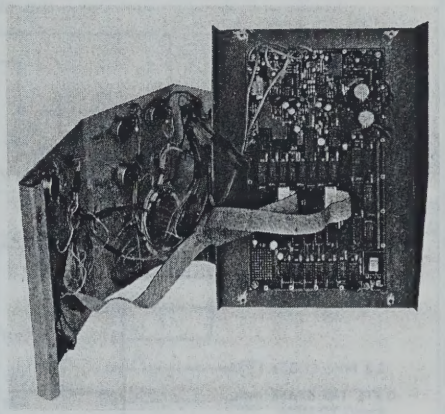


Fig 16—The W2IHY Audio Memory Keyer can store four messages, each containing up to 10 seconds of audio.

The audio keyer shown in Figs 16 through 18 was designed and built by Julius Jones, W2IHY.

W2IHY thanks Herb and Barbara Sweet, (K2GBH and WA2KCL) for their assistance with the project writeup. The audio keyer has the following features:

1) Four message memories each capable of storing up to 10 seconds of digitized audio
2) A message write/read (record/send) indicator
3) A microphone gain indicator
4) A built-in audio monitor
5) The ability to repeatedly read (send) a selected memory
6) Adjustable delays between repeats
7) Electronic control of transmitter push to talk (PTT)
8) Adjustable PTT sensitivity and delay controls
9) Voice-activated reset (VAR)
10) Adjustable VAR sensitivity control
11) Battery back-up capability

The audio keyer is designed using commonly available components, including 74HC series high-speed CMOS, 256k × 1-bit dynamic random-access memory (DRAM) chips, LM1458N operational amplifiers, linear voltage regulators and an Analog Devices eight-bit analog-to-digital / digital-to-analog converter (ADC7569JN) containing an on-chip track and hold circuit.

The audio keyer can be constructed, using all new parts, for about $185. A single-message version can be built for about $130 by replacing the 256k DRAM ICs with 64k ICs (150 ns or 120 ns). The single-message keyer may be later upgraded to full capacity simply by installing 256k ICs. All the parts are available from Jameco Electronics[1] and Mouser Electronics[2] except the A-to-D converter which is available from Analog Devices[3].

The keyer has been used in high RF environments without any problems. It has also been used in a multi-band SSB contest. On-the-air tests indicate that other stations find it difficult to distinguish between live signals and keyer-generated signals.

[1]Jameco Electronics, 1355 Shoreway Road, Belmont, CA 94002, tel 415-592-8121.
[2]Mouser Electronics, 2401 Hwy 287 North, Mansfield, TX 76063, tel 1-800-346-6873.
[3]Analog Devices Inc, Rt 1 Industrial Park, Norwood, MA 02062-9106, tel 617-329-4700. (AD7569JN may be phone ordered).

Circuit Description

The schematic of the DVR is shown in Fig 17, and a block diagram of the keyer is shown in Fig 18. Audio from the microphone is amplified through two cascaded operational amplifiers. The audio microphone level control (R49) sets the gain of the second stage of amplification.

The output of the microphone amplifier is sent to a six-pole unity-gain low-pass filter and to an analog audio switch. (The audio switch will be discussed later.) The low-pass filter removes high frequencies present in the amplified microphone signal. The 3-dB cut-off frequency of the filter is 1.8 kHz.

The output of the microphone low-pass filter is sent to the analog-to-digital converter (ADC), microphone-level indica-

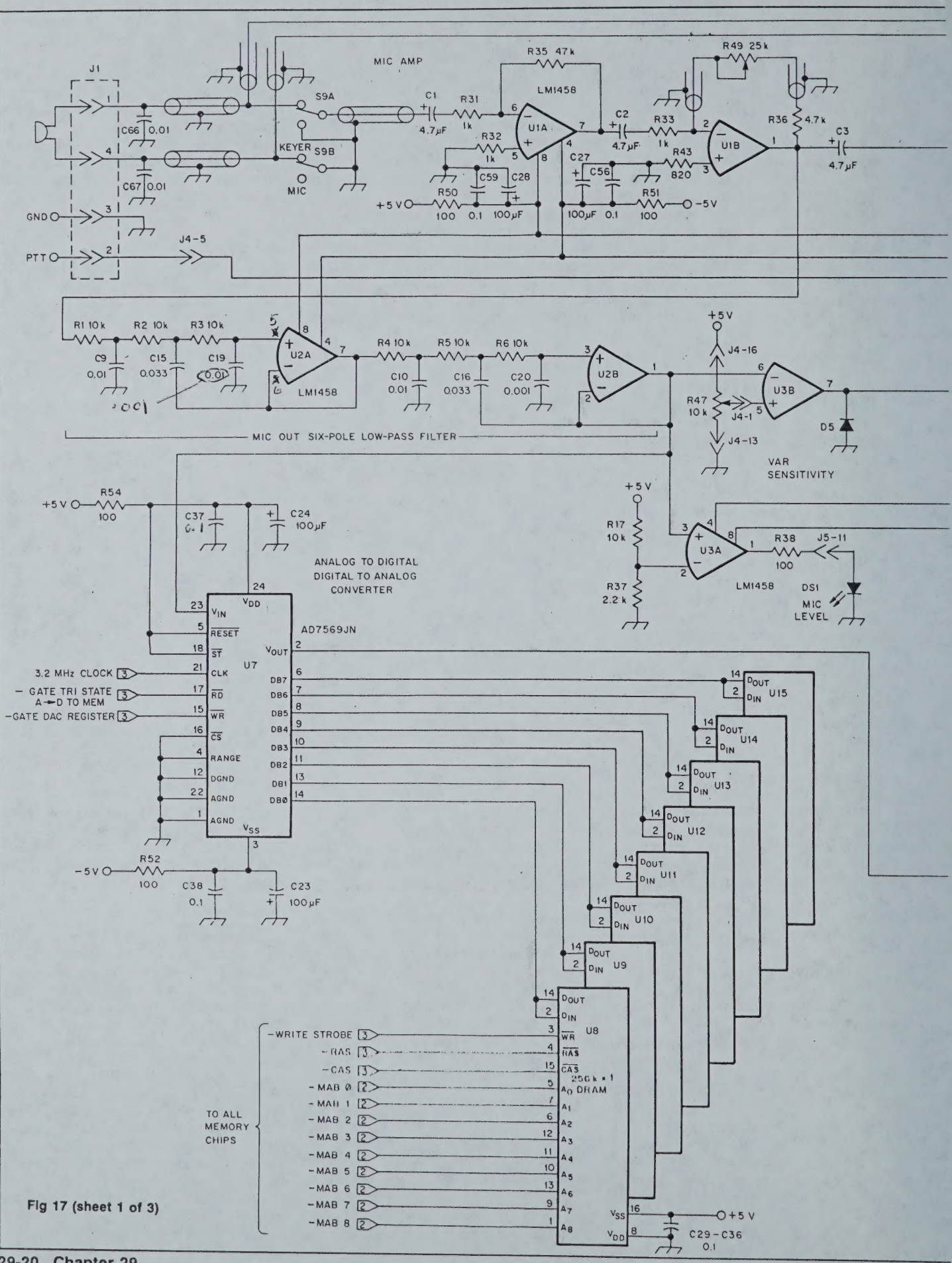
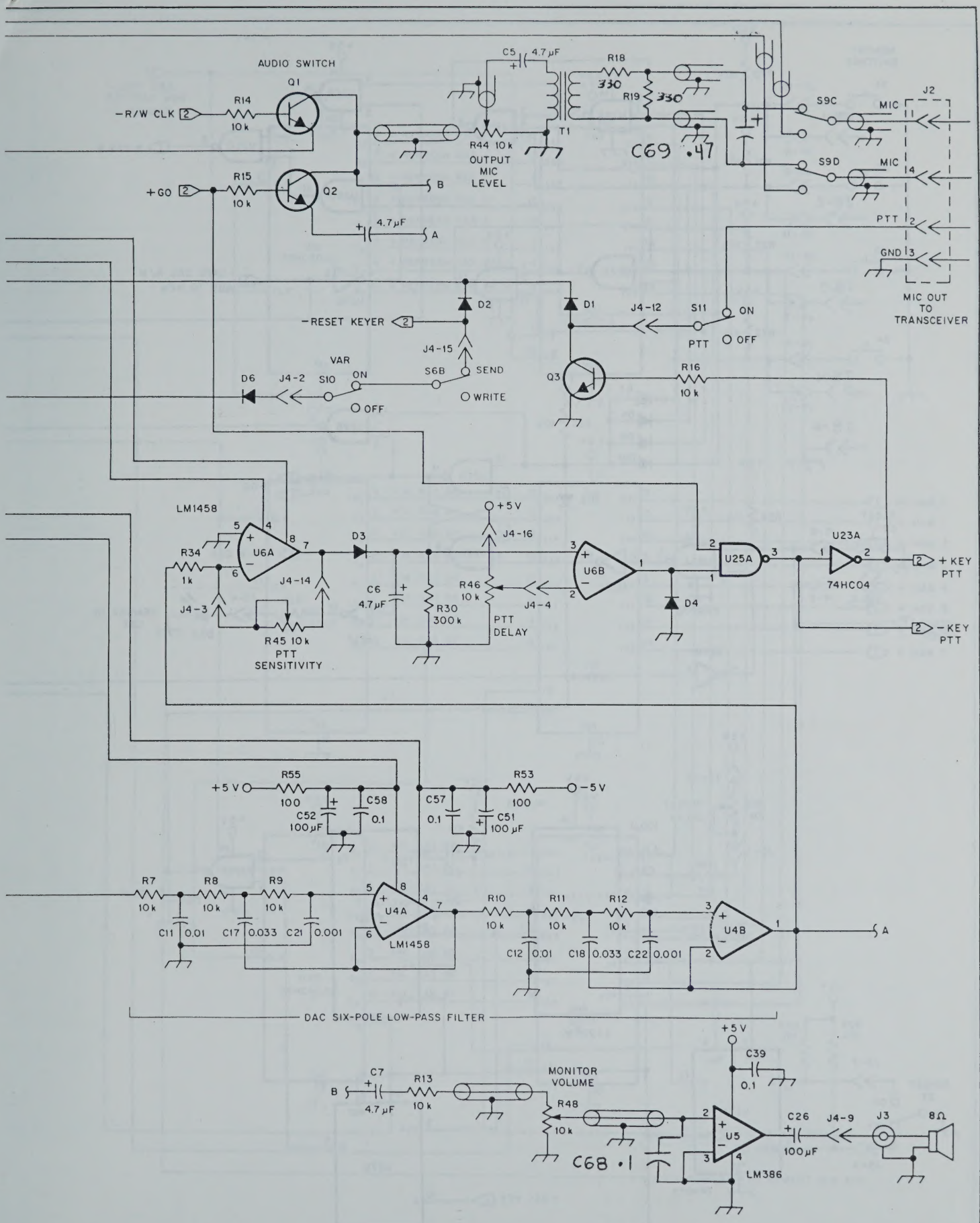


Fig 17 (sheet 1 of 3)



NOTE: ALL COAX SHIELDS SHOULD BE GROUNDED AT BOTH ENDS

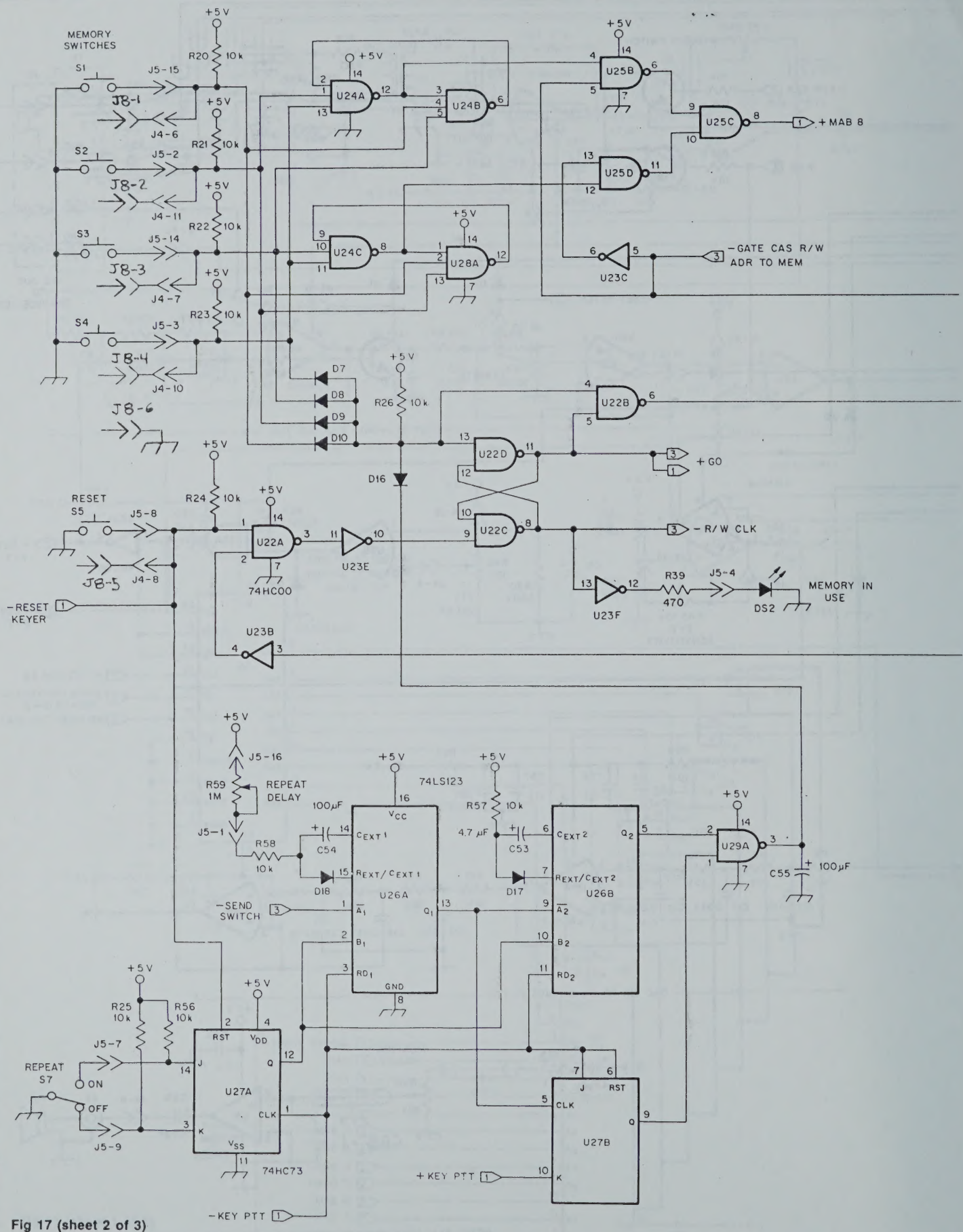
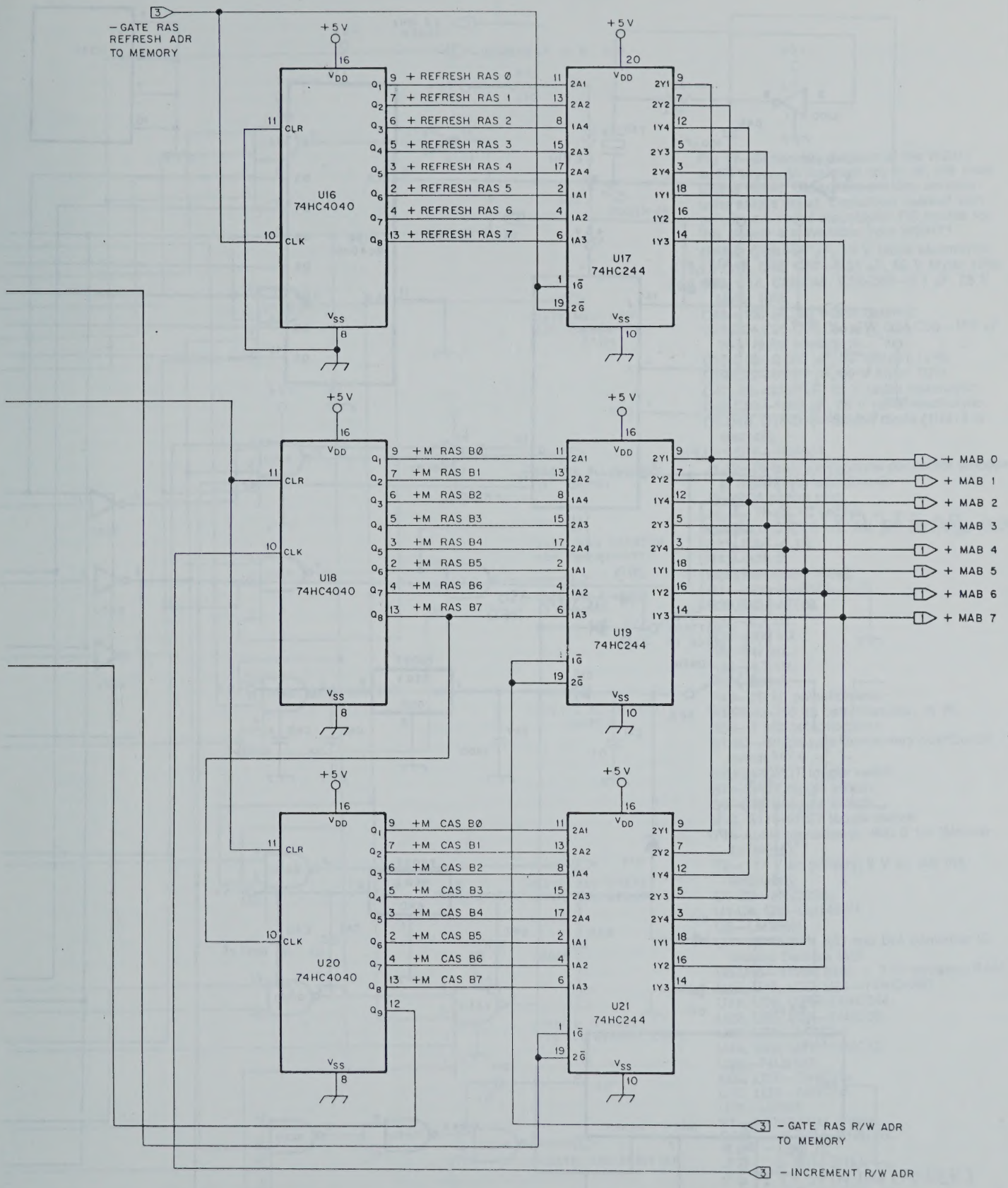


Fig 17 (sheet 2 of 3)


3
- GATE RAS REFRESH ADR TO MEMORY
+5 V
U16
74HC4040
CLR
CLK
+ REFRESH RAS Ø
+ REFRESH RAS 1
+ REFRESH RAS 2
+ REFRESH RAS 3
+ REFRESH RAS 4
+ REFRESH RAS 5
+ REFRESH RAS 6
+ REFRESH RAS 7
U17
74HC244
U18
74HC4040
+M RAS BØ
+M RAS B1
+M RAS B2
+M RAS B3
+M RAS B4
+M RAS B5
+M RAS B6
+M RAS B7
U19
74HC244
+ MAB 0
+ MAB 1
+ MAB 2
+ MAB 3
+ MAB 4
+ MAB 5
+ MAB 6
+ MAB 7
U20
74HC4040
+M CAS BØ
+M CAS B1
+M CAS B2
+M CAS B3
+M CAS B4
+M CAS B5
+M CAS B6
+M CAS B7
U21
74HC244
- GATE RAS R/W ADR TO MEMORY
- INCREMENT R/W ADR

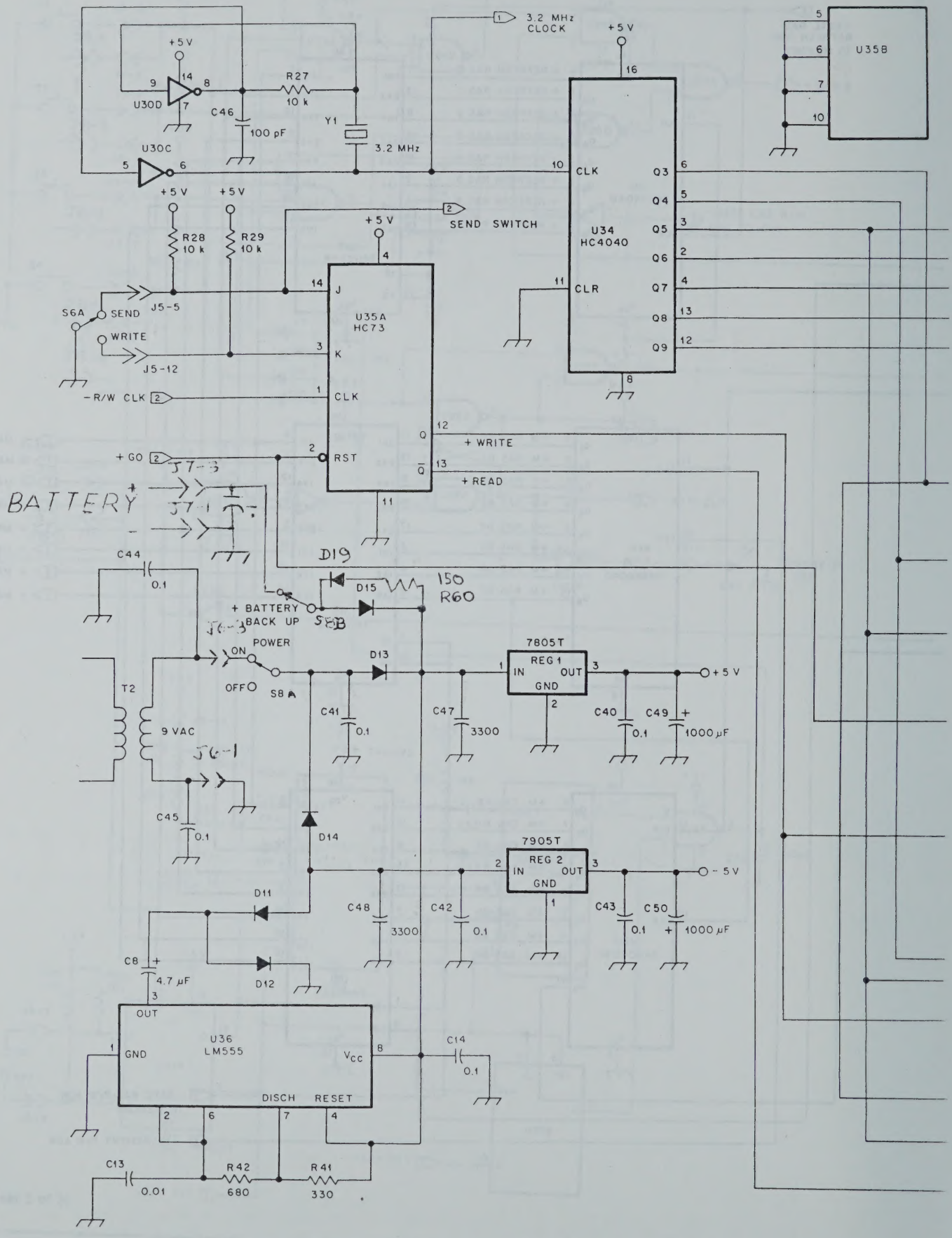


Fig 17 (sheet 3 of 3)

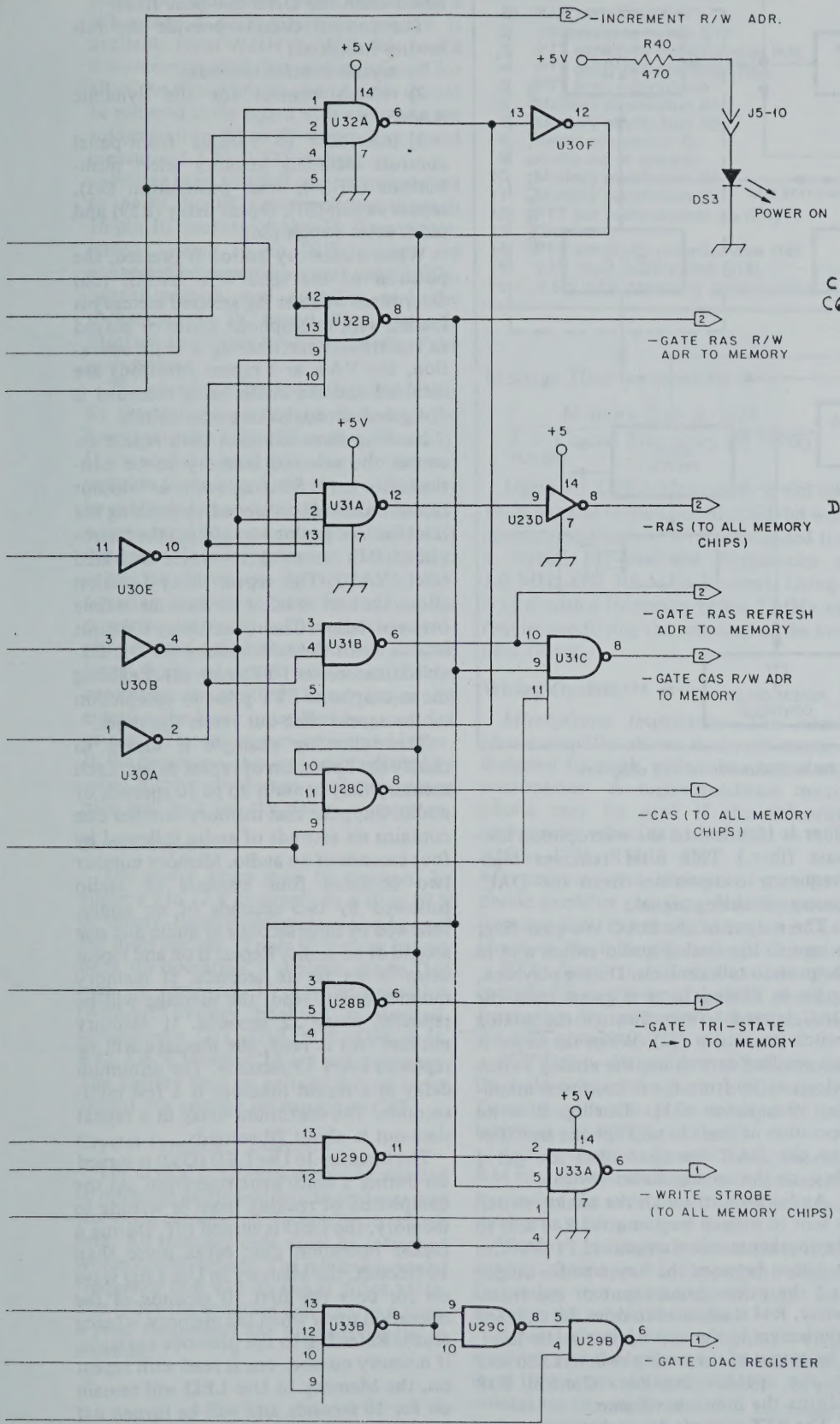


Fig 17—Schematic diagram of the W2IHY audio keyer. All resistors are ¼ W, 5% units unless noted. Capacitors are disc ceramic units unless noted. Capacitors marked with polarity are radial electrolytic. PC boards for this project are available from W2IHY[4].

C1-C8, C53—4.7 μF, 16 V radial electrolytic.
C13, C9-C12, C66, C67—0.01 μF, 50 V Mylar 10%.
C68 [redacted], C14, C29-C45, C56-C65—0.1 μF, 25 V Mylar 10%.
C46—100 pF, 50 V disc ceramic.
C23,C24,C26-C28,C51,C52,C54,C55—100 μF, 16 V radial electrolytic.
C15-C18—0.033 μF, 50 V Mylar 10%.
C19-C22—0.001 μF, 50 V Mylar 10%.
C47, 48—3300 μF, 25 V radial electrolytic.
C49,C50—1000 μF, 25 V radial electrolytic.
D1-D10, D16-D18—Silicon diode (1N914 or 1N4148).
D19, D11-D15—1N4001.
J1,J2—Female microphone connector (choose to match your equipment).
J3—RCA phono plug.
J4,J5—16-pin IC socket.
[redacted], R56-R58—10 kΩ. R1-R17, R20-R29
R31- R34—1 kΩ.
R43—820 Ω.
R38, R50-R55—100 Ω.
R41—330 Ω. R18, R19
R39,R40—470 Ω.
R37—2.2 kΩ.
R30—300 kΩ.
R35—47 kΩ.
R36—4.7 kΩ.
R42—680 Ω.
R49—25 kΩ potentiometer.
R44-R48—10 kΩ potentiometer, ½ W.
R59—1 MΩ potentiometer.
S1-S5—Single-pole momentary pushbutton switch.
S6,S8—DPDT toggle switch.
S7—SPDT toggle switch.
S9—4PDT toggle switch.
S10, S11—SPST toggle switch.
T1—Audio transformer, 600 Ω 1:1 (Mouser 42TM016).
T2—117 V ac primary, 9 V ac 500 mA secondary.
Q1-Q3—2N2222A.
U1-U4, U6—LM1458N.
U5—LM386N.
U7—AD7569JN A/D and D/A converter IC; Analog Devices Inc[3].
U8-U15—41256 256k × 1-bit dynamic RAM.
U16, U18, U20, U34—74HC4040.
U17, U19, U21—74HC244.
U22, U25, U29—74HC00.
U23, U30—74HC04.
U24, U28, U31—74HC10.
U26—74LS123.
U27, U35—74HC73.
U32, U33—74HC20.
U36—LM555.
Y1—3.2768 MHz crystal.
C69 - .47 μF RADIAL
R60 - 150 Ω
J8 6 PIN DIN
J6, J7 - 3 PIN DIN (POWER)
(J6 - AC/DC PWR
J7 - AUX PWR / BATTERY BACK UP (NICADS))

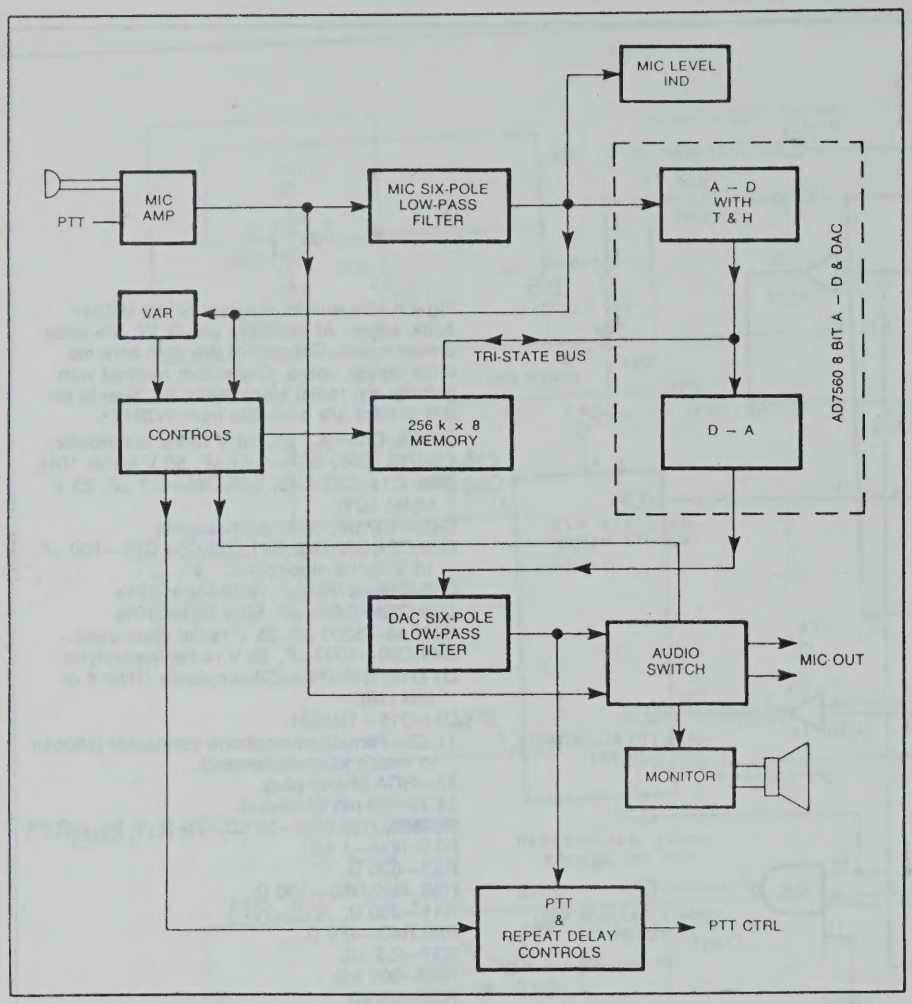


Fig 18—Block diagram of the audio keyer. See text for a discussion of this diagram.

tion circuitry and VAR circuitry. The ADC samples the low-pass filter output and converts it into an 8-bit data word.

Signals sampled by the ADC exceeding ±1.25 volts will be clipped to ±1.25 volts. The microphone level LED (DS1) provides visual indication when the input level to the ADC is near +1.25 V. The microphone-level indicator is turned on when the ADC is sent a signal from the microphone low-pass filter exceeding 0.9 V. The microphone low-pass filter output is also sent to the voice-activated reset (VAR) circuitry. When activated, VAR allows the audio keyer to be reset when you speak into the microphone. This is analogous to resetting a CW memory keyer by tapping the paddle. VAR sensitivity potentiometer R47 establishes the microphone low-pass filter level that will reset the keyer.

The output of the ADC is sent to eight 256k × 1 DRAM chips. The control circuits allow the digitized microphone input to be stored in the memory.

To send (play back) data stored in memory, an eight-bit word is read from memory and sent to the DAC, where the data is restored to analog form.

The output of the DAC is sent to a six-pole low-pass filter. (The DAC low-pass filter is identical to the microphone low-pass filter.) This filter removes high-frequency components from the DAC-generated analog signal.

The output of the DAC low-pass filter is sent to the analog audio switch and to the push-to-talk controls. During playback, audio in analog form is gated from the DAC low-pass filter through the analog switch (transistor Q2). When the keyer is not sending or writing, the analog switch selects audio from the microphone amplifier (transistor Q1). During a write operation neither the microphone amplifier nor the DAC low-pass filter are gated through the analog audio switch.

Audio gated through the analog switch is sent to output level control R44 and to the speaker monitor amplifier. T1 provides isolation between the keyer audio output and the microphone input of the transceiver. R44 is adjusted to drive the attached transceiver to the appropriate audio level. The output of the analog switch is also sent to the speaker monitor. Control R48 adjusts the monitor volume.

The PTT controls detect audio sent from the DAC low-pass filter. When audio is detected, transistor Q3 grounds the transceiver's PTT. Adjustment of the PTT sensitivity control (R45) determines the DAC low-pass filter level that will ground the transceiver's PTT. The delay (PTT) control (R46) determines the length of time Q3 is grounded after the absence of detected audio from the DAC low-pass filter.

The control circuits provide the following functions:

1) crystal control timebase

2) refresh control for the dynamic RAMS

3) interfaces to various front-panel controls including memory select pushbuttons (S1-S4), reset pushbutton (S5), repeat switch (S7), repeat delay (R59) and send/write switch (S6).

When a memory button is pressed, the position of the send/write switch (S6) determines whether the selected memory is loaded with microphone audio or played to the transceiver. During a write operation, the VAR and repeat functions are disabled and the audio being recorded is not gated through the audio switch.

Sending recorded data with repeat on causes the selected memory to be continuously read. Sending (with or without repeat on) may be stopped by pushing the reset button, pushing (enabling) the microphone PTT or using the voice activated reset (VAR). The repeat delay function allows the user to select the amount of time between delays. The repeat delay time-out begins when the microphone PTT is disabled (transceiver PTT unkeyed). Enabling the microphone PTT prior to completion of the repeat time-out resets the timer.

The following example is meant to clarify the operation of repeat delay. Each memory may contain up to 10 seconds of audio. Suppose that memory number one contains six seconds of audio followed by four seconds of no audio. Memory number two contains four seconds of audio followed by two seconds of no audio, followed by three seconds of audio and one second of no audio. Repeat is on and repeat delay is set to six seconds. If memory number one is read, the message will be repeated every 12 seconds. If memory number two is read, the message will be repeated every 15 seconds. The minimum delay in a repeat time-out is a few milliseconds. The maximum delay in a repeat time-out is about 20 seconds.

The Memory In Use LED (DS2) is turned on during a send/write operation. At the completion of reading from or writing to memory, the LED is turned off. During a repeat operation that takes more than 10 seconds, the Memory In Use LED stays on for only the first 10 seconds of the operation (only when the memory is being read). Referring to the previous example, if memory number one is read with repeat on, the Memory In Use LED will remain on for 10 seconds and will be turned off for two seconds. If memory number two was read, the Memory In Use LED would remain on for 10 seconds and would be turned off for five seconds.

Construction

Point-to-point or wire-wrap methods can be used to construct the keyer. A glass-epoxy double-sided board with plated-through holes, solder mask, and a silk-screened parts-placement pattern is available from W2IHY[4]. With this board it is recommended that sockets be used for all of the ICs. Also, all components should be soldered to the board with a low-wattage soldering iron (25 to 40 watts). The board measures 5.5 by 9.375 inches.

Wiring most switches and potentiometers to the PC board is accomplished through 16-pin IC sockets J4 and J5. Two single-ended 24-inch 16-pin DIP jumpers are connected between the various panel LEDs, potentiometers and switches and the sockets on the PC board. The schematic diagram and Table 1 provide details of the connections.

The memory select and reset pushbuttons S1 through S5 can be connected to the board through either IC socket (J4 or J5). If one socket is used to connect front-panel switches to the board, the other socket may be connected to an external source (through a connector) to provide remote control of the keyer. It is important to use shielded cables as shown on the schematic. Decoupling capacitors must be used at the power connectors (0.1 μF) and at the microphone input connections (0.01 μF) to the keyer. Spurious signals will be heard if the capacitors are omitted. Power (ac or dc) entering the keyer must first be grounded on the PC board to prevent ground loops. In the prototype, this was accomplished by using a three-conductor miniature stereo plug and jack for the power connectors.

Power Supply

The audio keyer may be powered by either a 9 to 12 V ac supply or a 10 to 20 V dc supply. Battery backup may also be used for short periods. If only 12 V dc or battery back up operation is desired, diode D14 may be removed. If only ac operation (without battery backup) is desired, components D11, D12, D15, U36, R41, R42, C8, C13 and C14 are not necessary. The battery backup voltage should never exceed the voltage on capacitor C47.

Crystal Frequency Selection

The crystal frequency should be selected to optimize audio bandwidth and message size while considering the minimum refresh rate. All memory cells must be refreshed within 4 milliseconds. The minimum crystal frequency that will do this is 2.048 MHz. The following equation defines (for a given crystal frequency) the message length in seconds.

[4]PC boards and information available from: Julius D. Jones (W2IHY), 15 Vanessa Lane, Staatsburg, NY 12580, tel 914-889-4933.

Table 1
J4 and J5 Pin-outs

J4		*J5*	
Pin	*Signal*	*Pin*	*Signal*
1	VAR sensitivity R47	1	Repeat delay potentiometer R59
2	VAR reset to switch S10	2	Memory pushbutton S2
3	PTT sensitivity potentiometer R45	3	Memory pushbutton S4
4	PTT delay potentiometer R46	4	Memory In Use LED DS2
5	PTT from microphone	5	Send/write switch S6
6	Memory pushbutton S1	6	Ground
7	Memory pushbutton S3	7	Repeat switch S7
8	Keyer pushbutton S5	8	Keyer Reset pushbutton S5
9	Audio out to speaker	9	Repeat switch S7
10	Memory pushbutton S4	10	Power on LED DS3
11	Memory pushbutton S2	11	Microphone Level LED DS1
12	PTT out to transceiver (to S11)	12	SEND/WRITE switch S6
13	Ground	13	Not used
14	PTT sensitivity potentiometer R45	14	Memory pushbutton S3
15	VAR reset (from switch S10)	15	Memory pushbutton S1
16	+5 V VAR sensitivity potentiometer R47	16	+5 V to repeat delay potentiometer R59

$$\text{Message Time (in seconds)} = \frac{\text{Memory Size} \times 1024}{2 \times \text{Crystal Frequency (in hertz)}}$$

Using a 3.2768 MHz crystal, it will take 10.24 seconds to load one 65,536 8-bit word memory segment. It is recommended that a crystal between the frequencies of 3.0 MHz and 3.6 MHz be used. Using a crystal with a frequency below 3 MHz will require modifying the response of the low-pass filters.

Wiring Options

Microphone Impedance—The microphone amplifier shown in the schematic is designed to work with a low-impedance microphone. A high-impedance microphone may be used if the following component values are used: R31 = 47k, R35 = 470k, R32 = 47k.

Microphone Level—Control of the microphone amplifier gain is provided by potentiometer R49. Increasing the value of R49 increases the microphone amplifier gain.

PTT Sensitivity—Potentiometer R45 controls the sensitivity of the PTT circuitry. Increasing the resistance of R45 increases the PTT sensitivity.

PTT Delay—Potentiometer R46 controls the hold time of the push to talk circuit. Decreasing the voltage on the wiper of R46 increases the PTT hold time.

Audio Output Level—Potentiometer R44 controls the audio keyer output level. Increasing the resistance of R44 increases the keyer analog output level.

Monitor Volume—Potentiometer R48 controls the monitor audio output volume. Increasing the resistance of R48 will increase the monitor volume.

Voice Activated Reset Sensitivity—VAR sensitivity controls the microphone audio level that resets the audio keyer. As the voltage on the wiper of R47 is increased, higher microphone audio levels are required to reset the keyer.

Repeat Delay—Potentiometer R59 controls the delay between reading and rereading the memory. Increasing the resistance of R59 increases the delay between repeats.

Operating the Audio Keyer

When power is first applied to the keyer it may be sending or writing. Press the reset button or microphone PTT to cancel these operations. This will return the keyer to a known state.

Message Writing

While you talk into the microphone, adjust the microphone level control (R49) until the microphone level indicator (DS1) begins to light. Next set the send/write switch (S6) to the write position. Push one of 4 memory pushbuttons to load (write) a memory. *Do not press your PTT button at this point*; this will reset the keyer. The Memory In Use indicator (DS2) will stay on until the selected memory is full. It takes about 10 seconds to load a particular memory. During write operations the repeat, monitor output and VAR functions are automatically disabled.

Message Sending

Set the send/write switch (S6) to the send position. Turn off the repeat and VAR switches. Press one of the four memory pushbuttons to begin the send operation. The Memory In Use indicator (DS2) will stay on until the memory read operation is completed. Again, do not press the PTT switch at this point; this will reset the keyer.

PTT Sensitivity and PTT Delay

Follow the message sending procedure. Adjust the PTT delay to mid scale. Adjust the PTT sensitivity (R45) until the transceiver's push to talk is enabled. Adjust the PTT delay potentiometer (R46) for the desired hold time, and readjust the PTT sensitivity control if necessary.

Repeat and Repeat Delay

PTT sensitivity and PTT delay *must* be adjusted for desired operation. Turn on the repeat switch (S7). Follow the message sending procedure. Adjust R59 to obtain

the desired spacing between messages.

VAR and VAR Sensitivity

Turn on the Voice Activated Reset (VAR) switch (S10). Follow the message sending procedure. Talk into the microphone. Adjust the VAR sensitivity control (R47) until the keyer is reset.

Transceiver PTT Operation

Transceiver PTT operations may be activated by turning on switch S11 and either sending a message from the keyer or by pushing the microphone PTT. When the microphone PTT is depressed, the keyer is reset. Audio from the microphone is amplified and sent to the transceiver and the transceiver PTT is grounded (activated). Switch S11 should be turned off if VOX operation is desired.

Keyer Bypass

A four-pole double-throw switch (S9) is used to switch either the audio keyer or the microphone to the audio output jack. If S9 has switched the microphone directly to the transceiver, the keyer need not be powered on for the microphone and its PTT to be used with the transceiver.

Audio Output

The audio output control (R44) should be adjusted to drive the transceiver to the same audio level that is obtained from a directly connected microphone.

BOB—An RS-232-C Break-Out Box

The EIA RS-232-C interface standard greatly simplifies the interconnection of digital devices. When something goes wrong at an RS-232-C interface, however, the 25 signal lines and two equipment configurations—data terminal equipment (DTE) and data-circuit terminating equipment (DCE)—can easily confuse the troubleshooter. The RS-232-C break-out box (BOB) is a piece of test equipment used to simplify RS-232-C troubleshooting. Jeff Ward, K8KA, designed and built the break-out box described here in the ARRL lab.

Break-out boxes can be simple or very complex. In its simplest form, a break-out box displays the polarity of the voltage on an RS-232-C line. Deluxe break-out boxes monitor and change the voltages on several RS-232-C lines and alter the wiring at the interface between two RS-232-C devices. The deluxe break-out box is powerful, but expensive. Fortunately, many of the problems that amateurs will encounter can be diagnosed with a relatively simple break-out box.

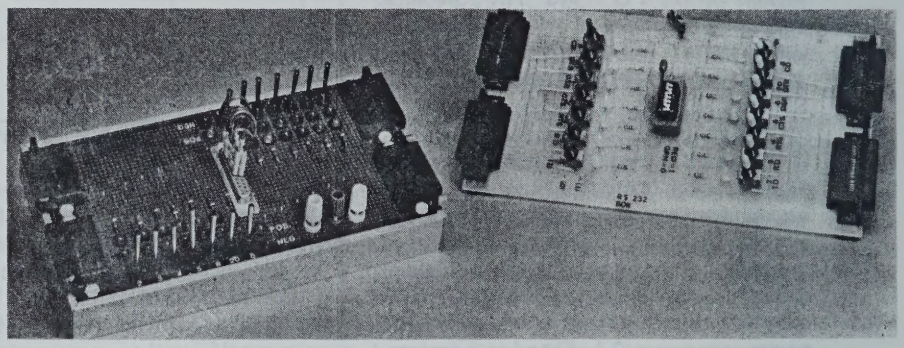


Fig 19—The final version of the RS-232-C break-out box uses PC-board construction. The prototype, built on a perforated board using wire-wrap techniques, performed just as well.

BOB

This project (Figs 19-23) describes the construction and use of BOB, an average break-out box. BOB is inexpensive, yet useful in many situations. It has the following features: a male and a female DB-25 connector at each end; a patch bay that allows any of the 7 most important lines at one end to be patched to any of the lines at the other end; the ability to set any line to +12 V or −12 V; and bi-color LEDs to indicate the polarity of the voltage on each line.

The circuit (Fig 20) is simple. Each of the signal lines (2,3,4,5,6,8 and 20) is brought from the DB-25 connectors to the DIP socket in the center of the BOB. The DIP socket acts as a patch bay. Any line from one pair of connectors can be patched to any line on the other pair. Each line is attached to a DPDT center-off toggle switch. One position of the switch sets the line to +12 V; the other position sets the line to −12 V. The OFF position lets the line "float" at the voltage applied to it by devices attached to BOB. Bi-color, polarity-

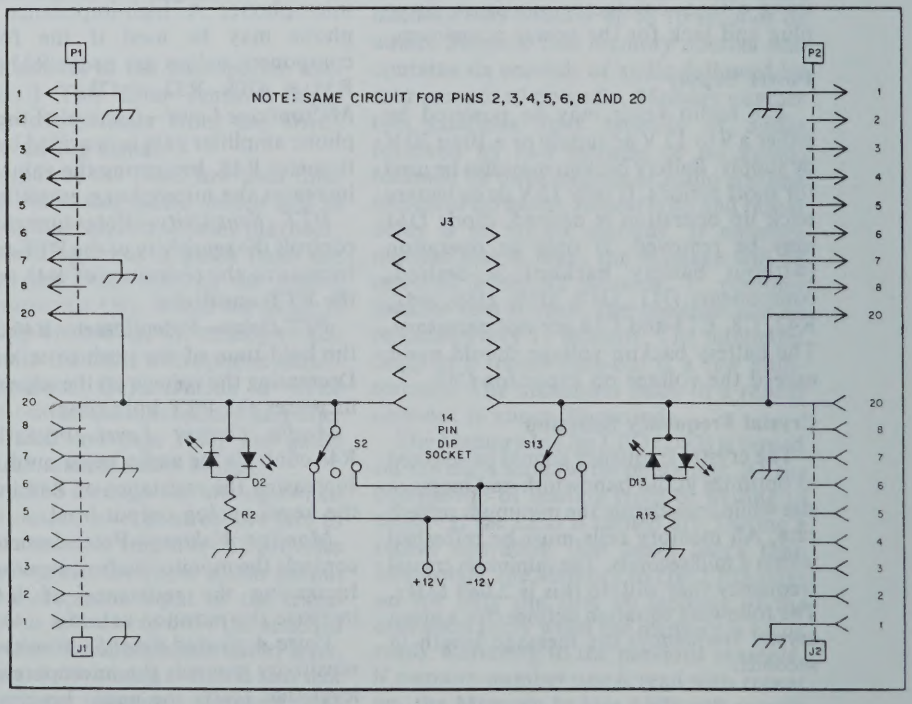
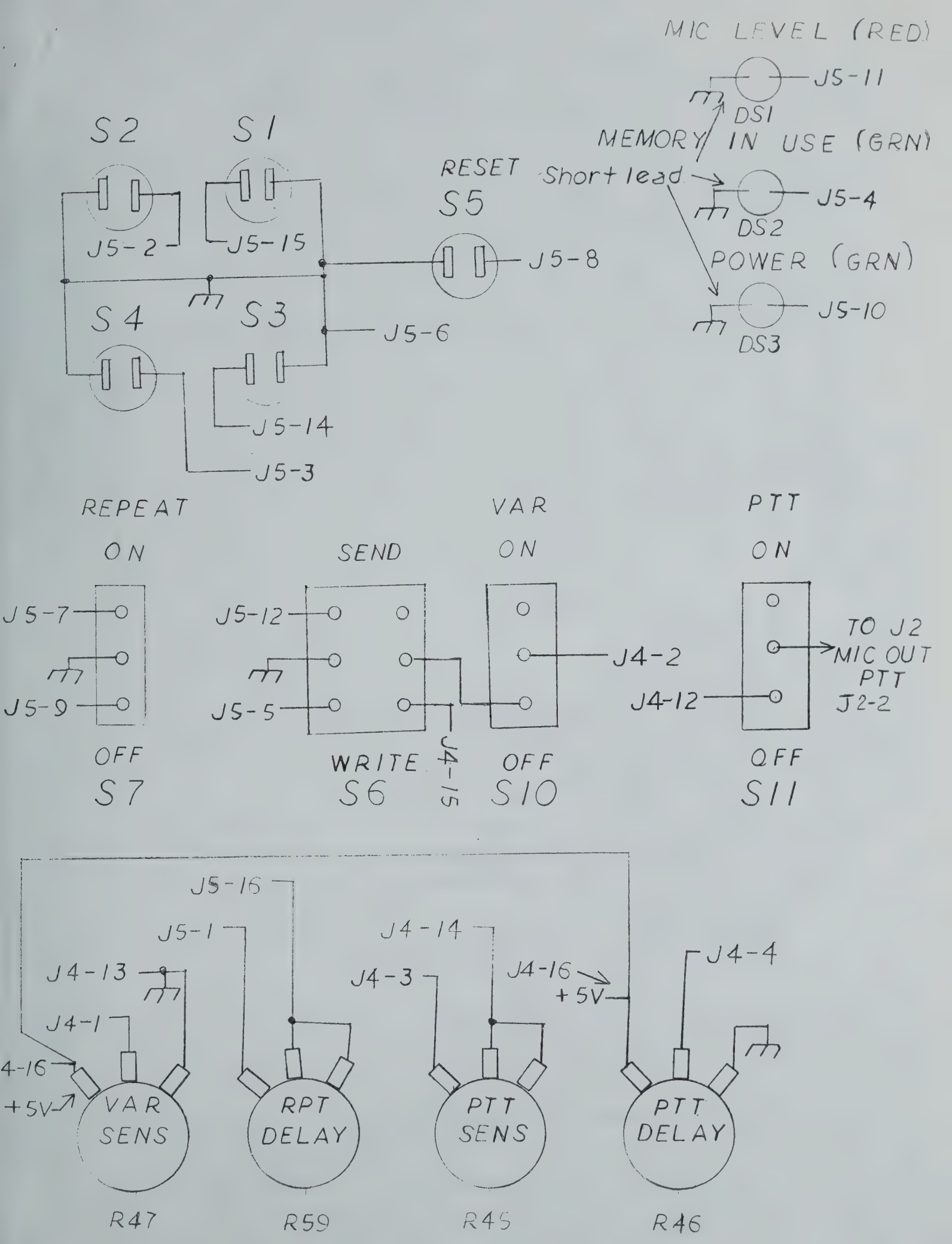
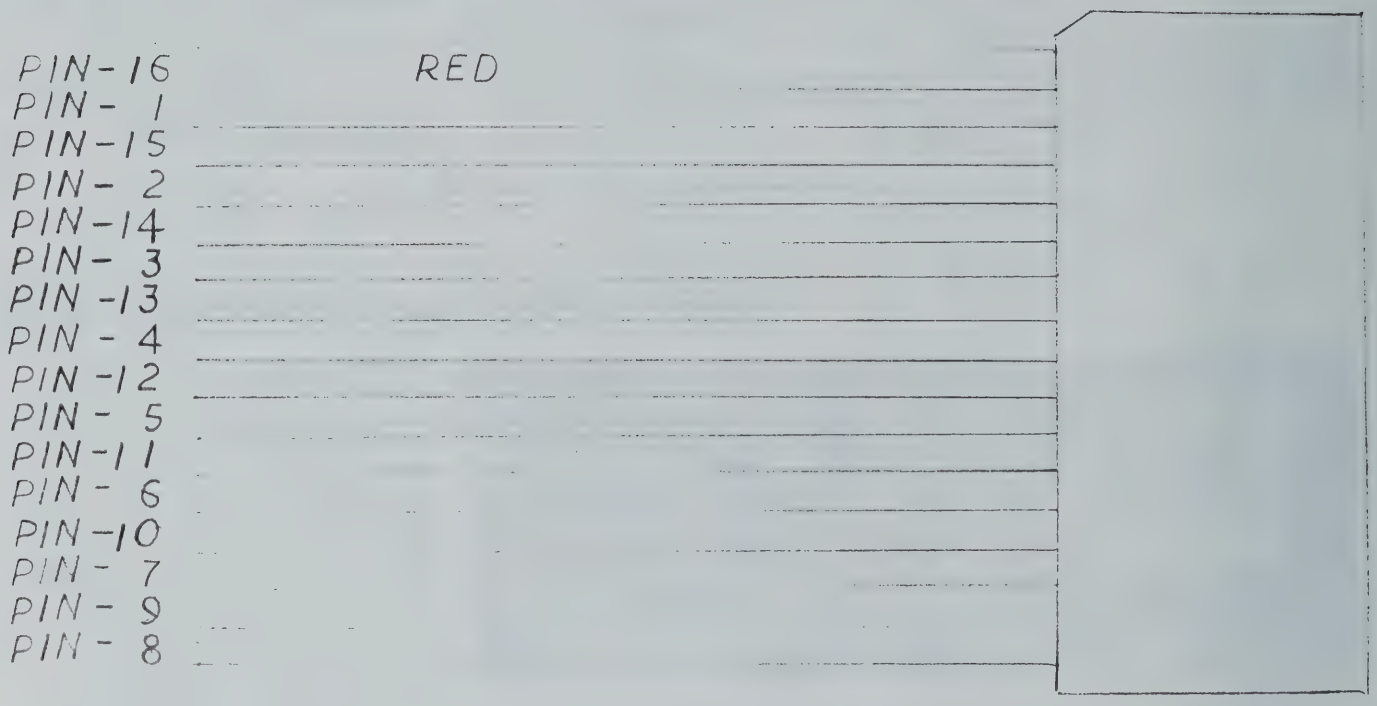


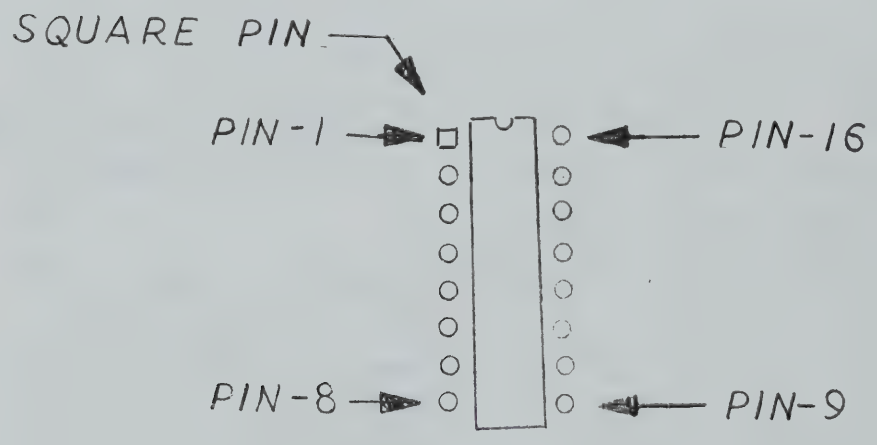
Fig 20—Schematic diagram for the RS-232-C break-out box. The same circuit is used for pins 2, 3, 4, 5, 6, 8 and 20.

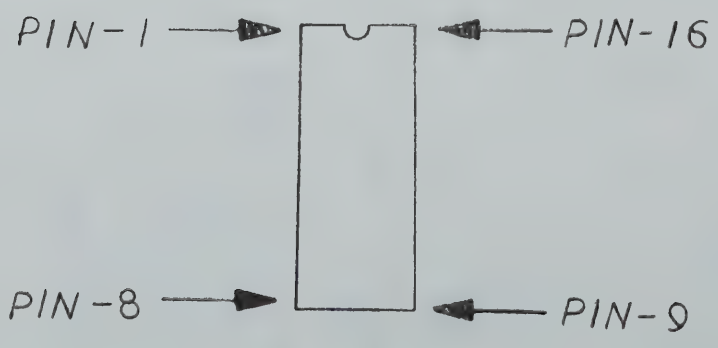
D1-D14—Bi-color LEDs (Jameco #XC5491 or equiv.).
J1, J2—DB-25-F (AMP 206584-2 or equiv.).
J3—14-pin DIP socket (3M 214-3339 or equiv.)
P1, P2—DB-25-M (AMP 206604-1 or equiv.).
R1-R14—1.2 kΩ, ¼ W.

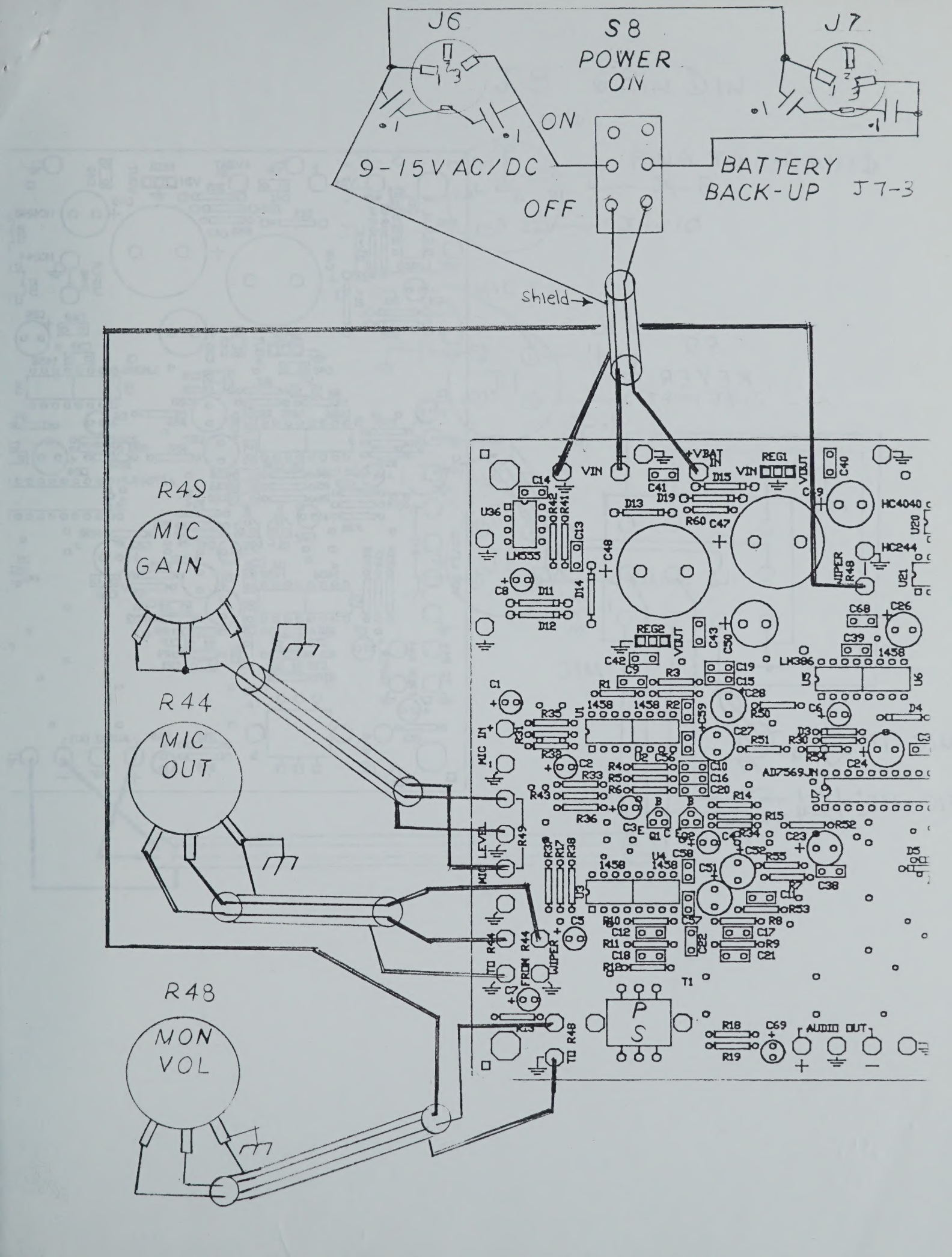

MIC LEVEL (RED)
J5-11
DS1
MEMORY IN USE (GRN)
Short lead
J5-4
DS2
POWER (GRN)
J5-10
DS3
S2
S1
RESET
S5
J5-2
J5-15
J5-8
S4
S3
J5-6
J5-14
J5-3
REPEAT
ON
J5-7
J5-9
OFF
S7
SEND
J5-12
J5-5
WRITE
S6
J4-15
VAR
ON
J4-2
OFF
S10
PTT
ON
J4-12
TO J2
MIC OUT
PTT
J2-2
OFF
S11
J5-16
J5-1
J4-13
J4-1
4-16
+5V
VAR SENS
R47
RPT DELAY
R59
J4-14
J4-3
PTT SENS
R45
J4-16
+5V
J4-4
PTT DELAY
R46

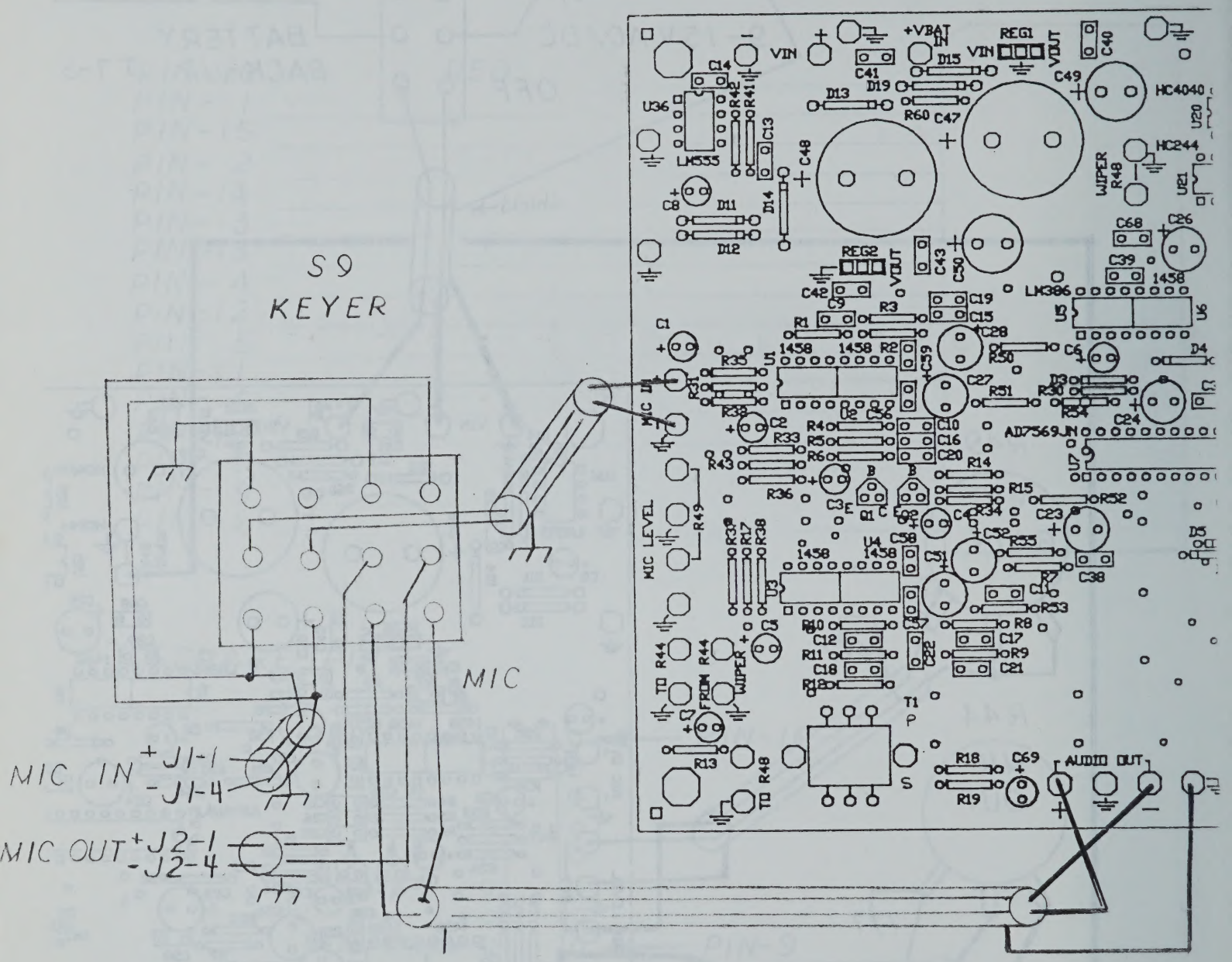
J4/J5 DIP JUMPER CABLE



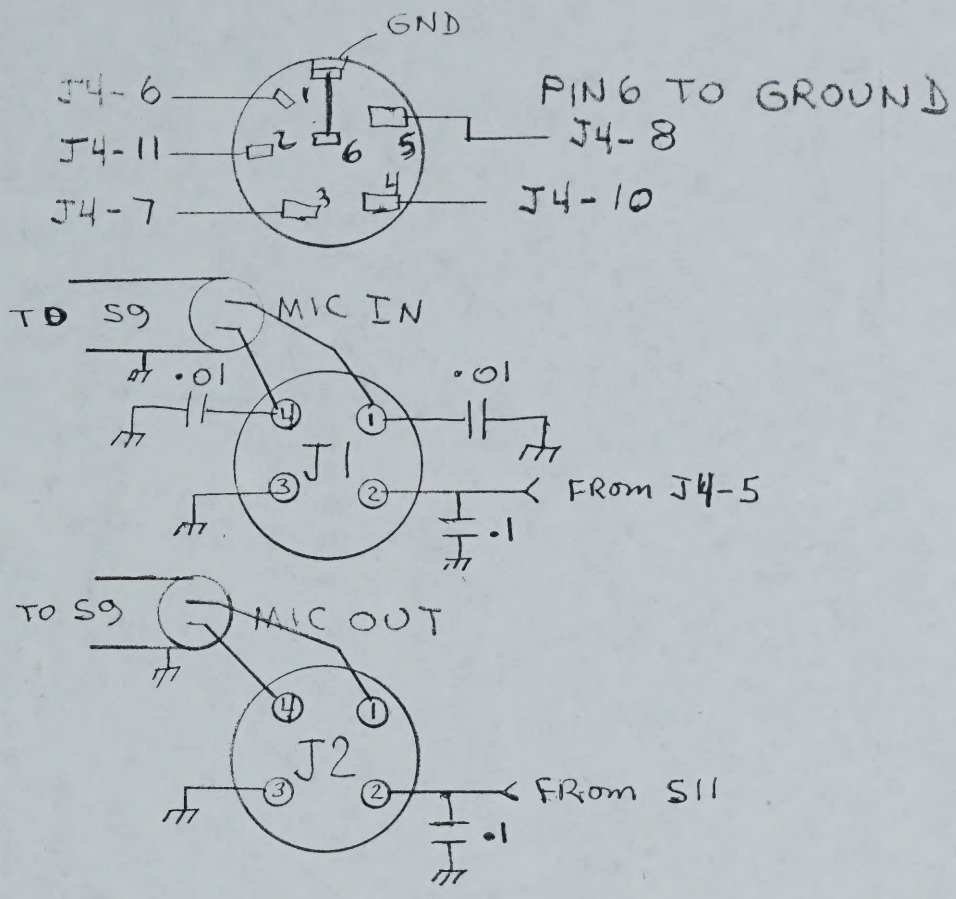





J6
S8
POWER
ON
J7
ON
9-15VAC/DC
BATTERY
BACK-UP
J7-3
OFF
shield
R49
MIC
GAIN
R44
MIC
OUT
R48
MON
VOL


S9
KEYER
MIC
MIC IN +J1-1
-J1-4
MIC OUT +J2-1
-J2-4
MIC LEVEL
WIPER
FROM
TO
VIN
+VBAT IN
REG1
REG2
VOUT
LM555
LM386
AD7569JN
HC4040
HC244
1458
AUDIO OUT

J8 6 PIN DIN


GND
J4-6
J4-11
J4-7
1
2
3
6
5
4
PIN 6 TO GROUND
J4-8
J4-10
TO S9
MIC IN
.01
.01
J1
FROM J4-5
.1
TO S9
MIC OUT
J2
FROM S11
.1

MIC LEVEL
MIC IN
TO R44
FROM R44
WIPER
R49
TO R48
R48
WIPER
VOUT
VIN
+VBAT
CRYSTAL
AUDIO OUT
LM386
AD7569JN
HC4040
HC244
HC373
1458
CONN